The return of the 5 year plan

Mathematical programming for allocation of health care resources

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This study

- Builds on existing decision framework
- Applying mathematical programming to a stylised but relevant policy problem
  - Profile of costs over time
  - Equity concerns are constraints
  - Allowing examination of equity-efficiency trade offs

Data

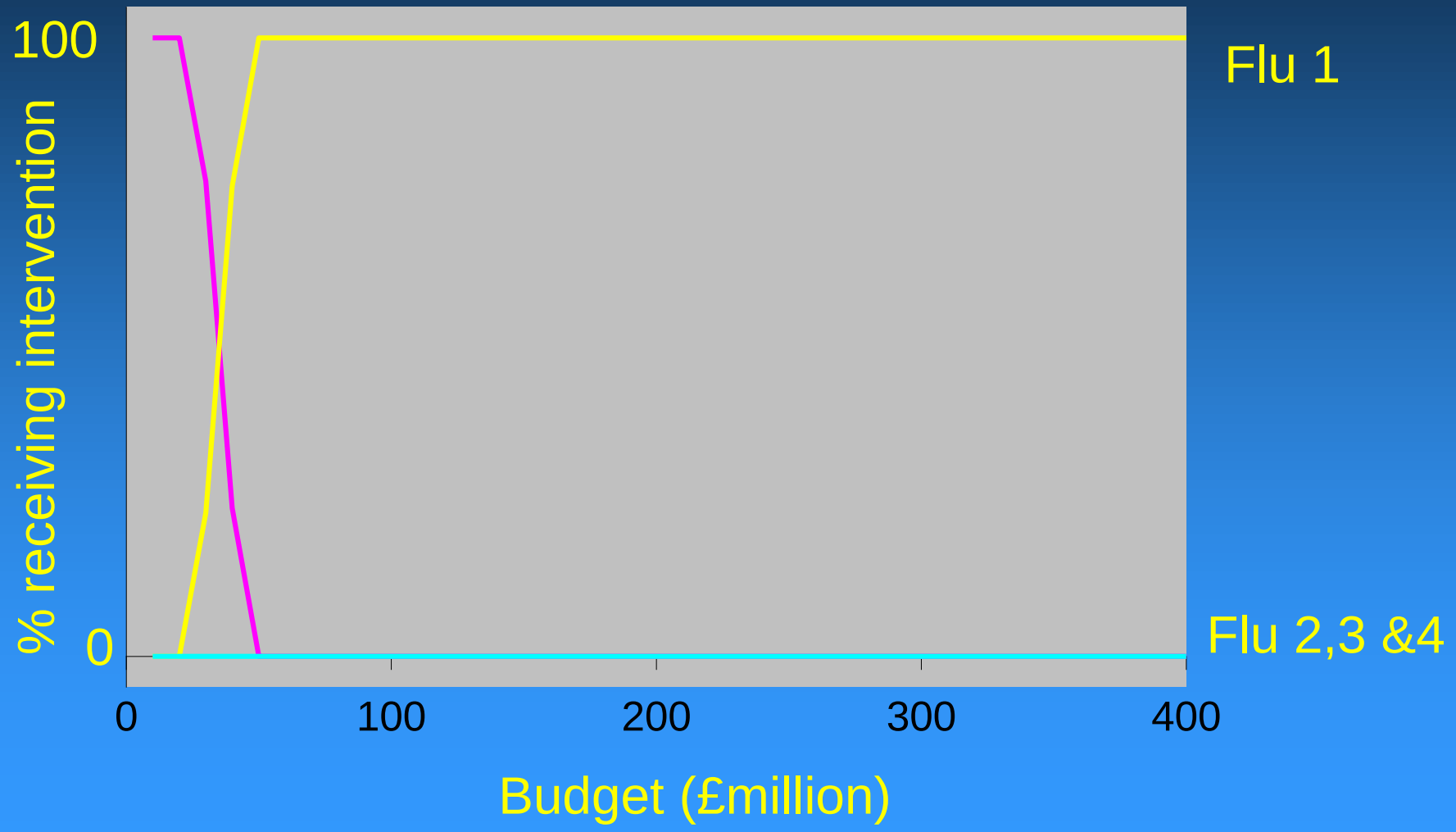
- Data from 6th wave UK NICE appraisals
  - Flu treatments (adults, elderly, residential elderly, children)
  - Rituximab (<60 years old, elderly)
  - Long acting insulin (type 1 diabetics, type 2 diabetics)
- Data available for each treatment:
  - costs for each year 1-15 (compared to 'current care')
  - total QALYs (compared to 'current care')
  - Prevalence and incidence
- Assume decision can be reviewed at 5 years

The problem

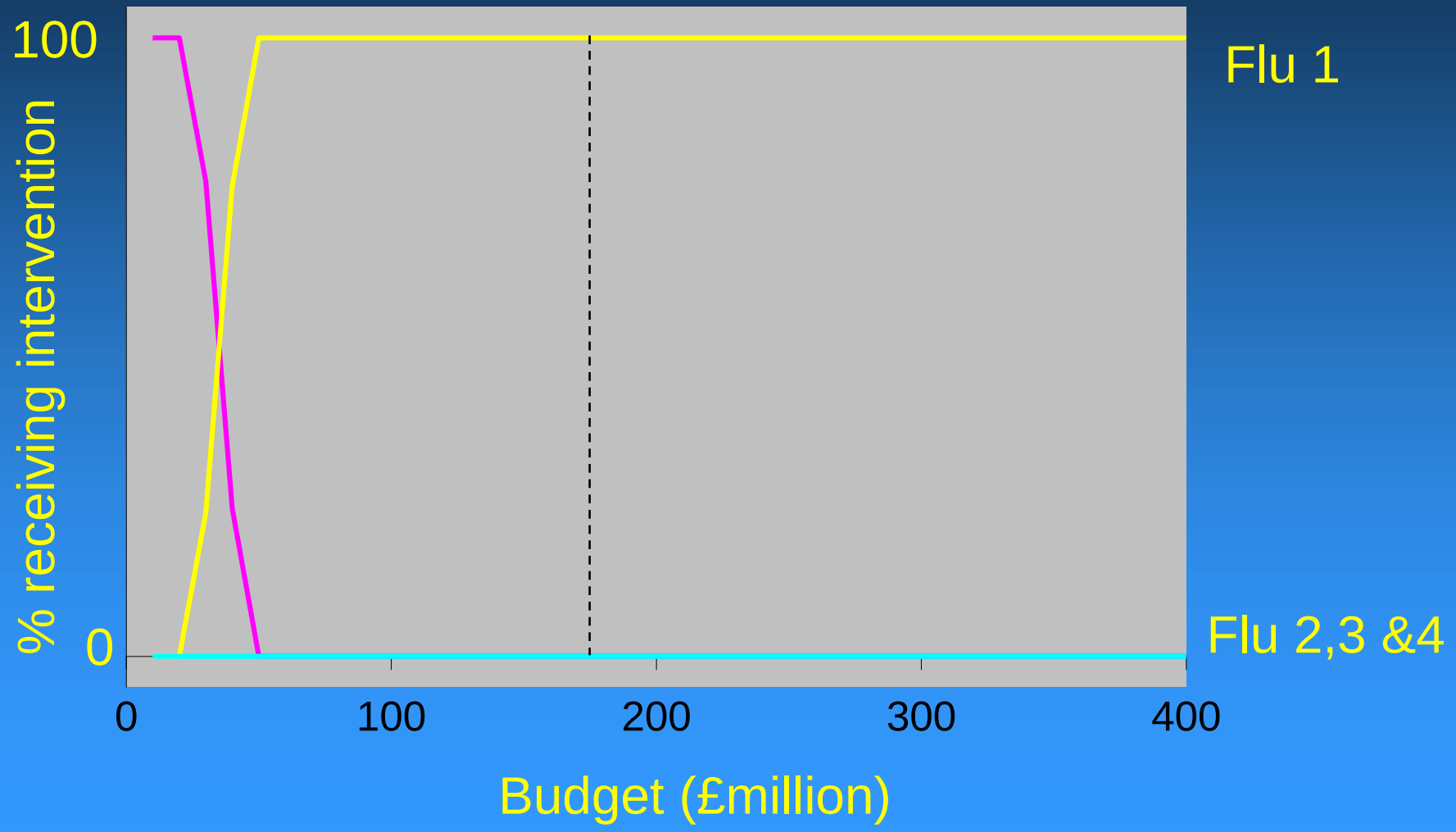
Maximise total (discounted) health benefits

- *subject to*
  - Total cost<= overall budget
- Interventions can be MIXED or PURE

Optimal solution



Optimal solution



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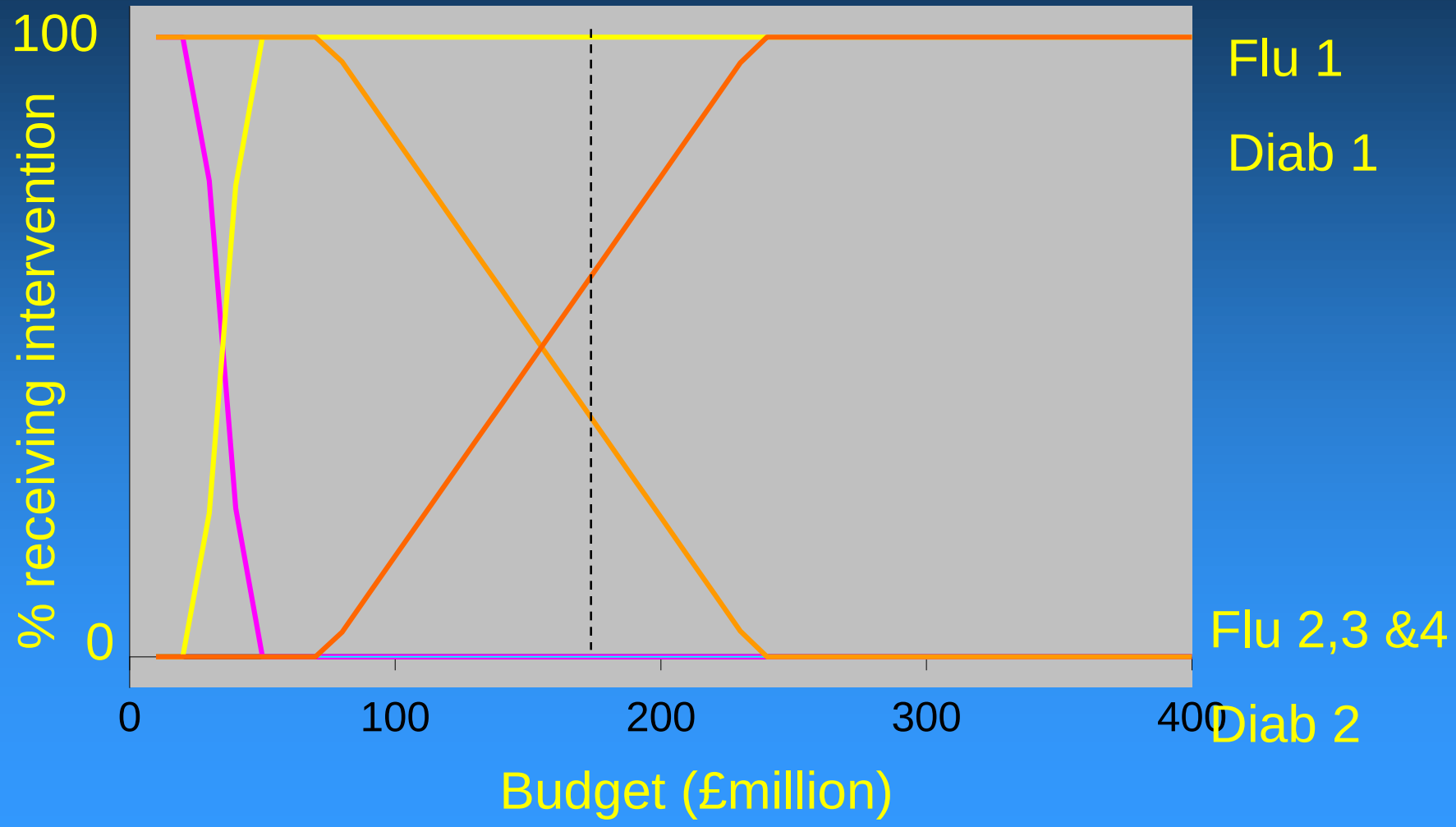

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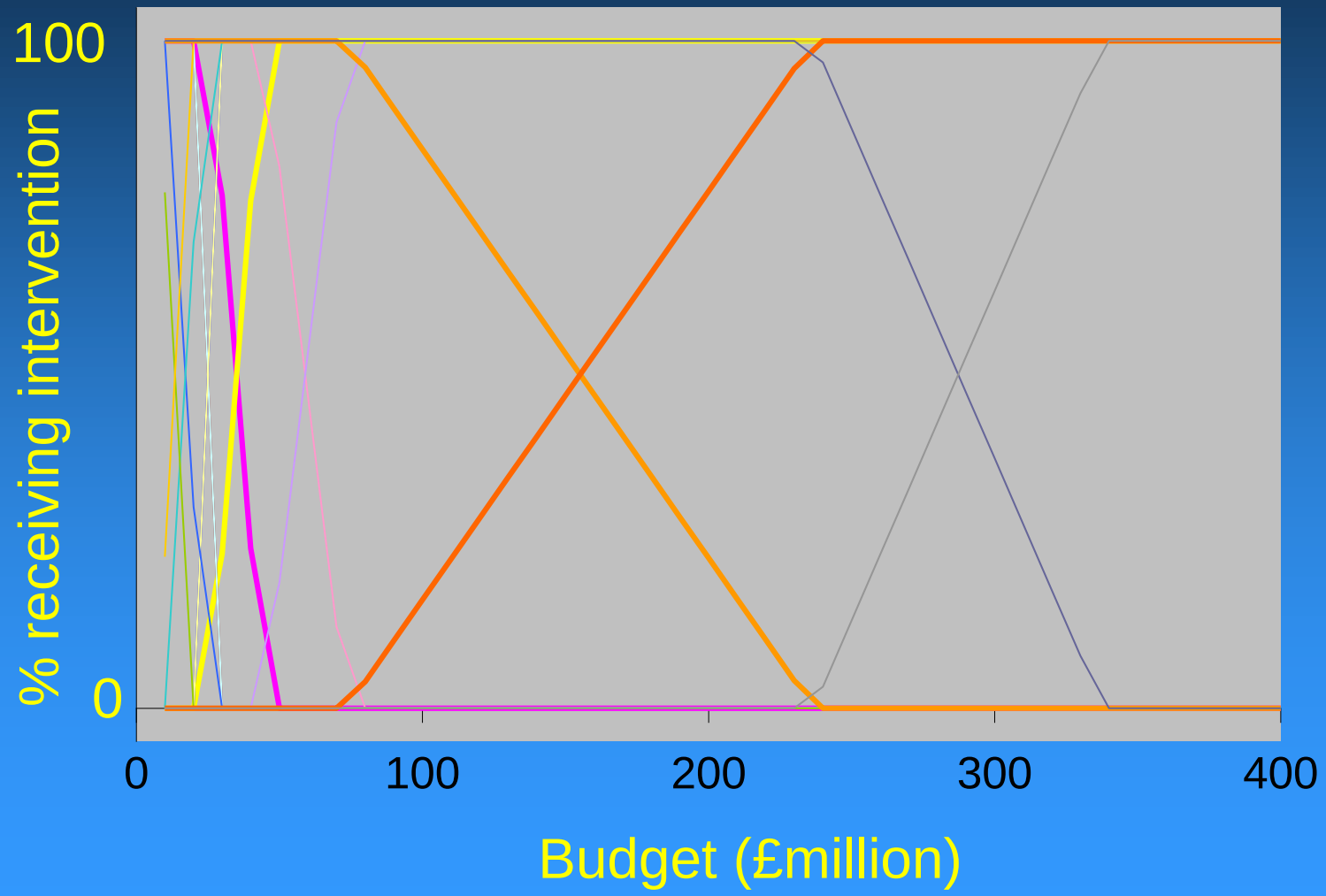
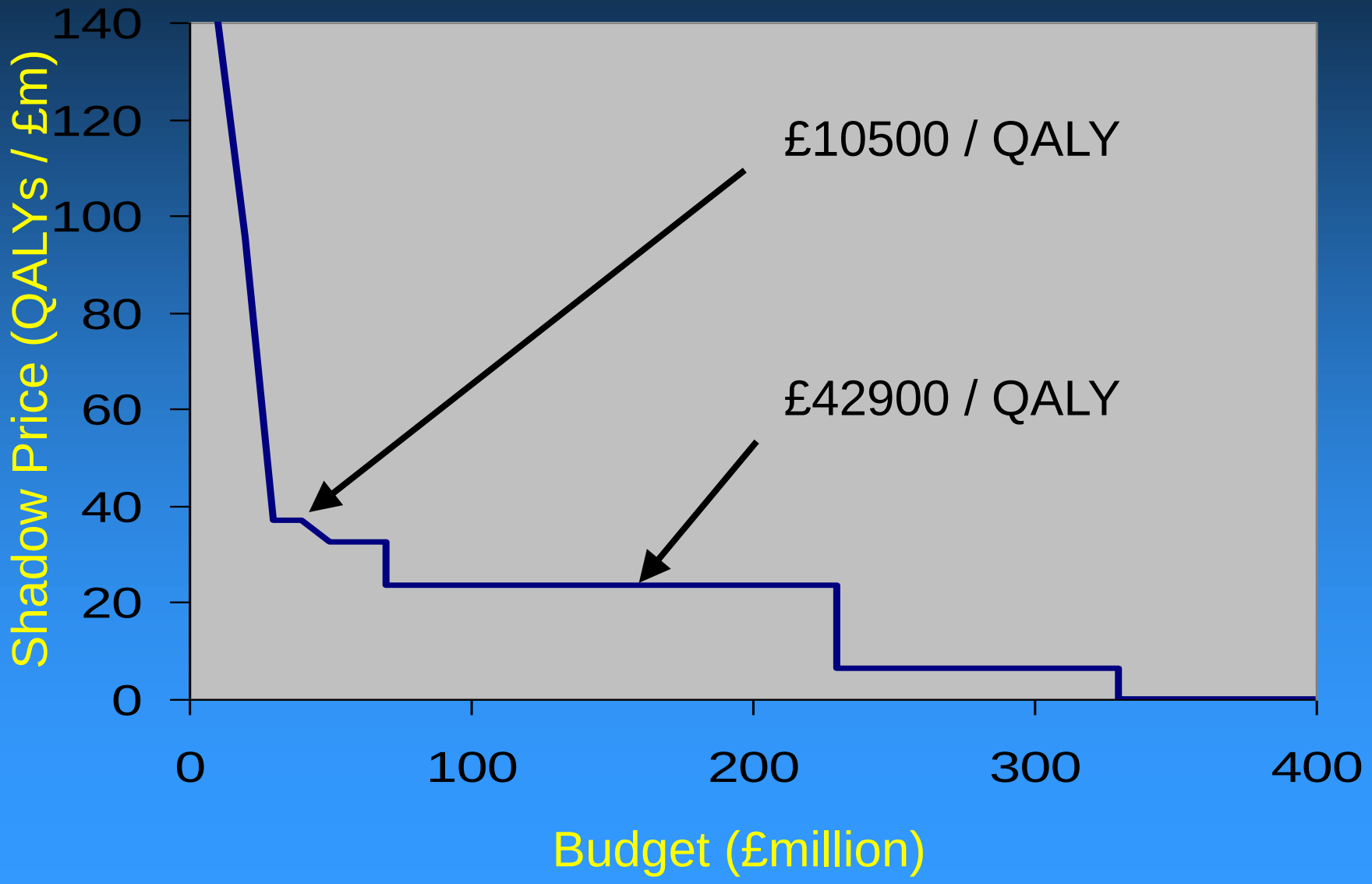


Shadow Price of budget constraint



Opportunity Loss of budget rules

Budget rule	Health gain (QALY)	Opp Loss (QALY)	Budget spent
No constraint	7317	0	£180m

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All in 1st 5 years	4879	2438	£75m

Indivisibility and horizontal equity

- Optimum solution allows mixed treatment options for some patient groups
- Requirement for horizontal equity is a constraint
- Can explore the opportunity loss of this equity concern on one or more programmes or populations

Indivisibility and horizontal equity

	Health gain (QALY)	Opp. Loss (QALY)
No equity constraint	3586	0
Equity popn. 1 (type 1 diabetes)	3066	520
Equity popn. 2 (age<60, lymphoma)	3547	19
Equity popn 1 and popn 2	3066	520

Equity between populations

- Usually acceptable to differentiate on basis of age
- Other more controversial examples might be gender or social class

Equity between populations

	Health gain (QALY)	Opp. Loss
No equity constraint	3586	0
Equity: programme 1 (lymphoma: older = younger)	3579	7
Equity: programme 2 (diabetes: type 1 = type 2)	3126	460
Equity prog 1 and prog 2	3122	464

Conclusions

- What has been done?
  - Used linear programming to assist a policy-relevant decision
- What does it show?
  - Shadow price varies with overall budget
  - The profile of cost over time is important
  - Different equity concerns have different implications for efficiency
- Further work
  - Uncertainty
  - Fixed costs and other non-linear functions
  - Repeat decisions
  - Resource as well as budget constraints

End of presentation